

Industrial control

Summary (2)

until end of SCADA

Smart sensors Part 4

→ Benefits of silicon technology in smart sensors:-

- 1) single chip solution.
- 2) very small in size.
- 3) Less space in configuration.
- 4) work with small signals.

Why smart sensors

↳ It enhances the following:-

a) self calibration :- (desired ^{value} ~~value~~) \sim Δ (deviation) \sim Δ (deviation) \sim Δ (deviation)

b) Communication :- status Δ (info.) Δ (broadcast) Δ (broadcast)

c) Computation

variance (average) Δ (average) Δ (average) Δ (average)
و (standard deviation) (standard deviation) (standard deviation) (standard deviation)

d) multisensing

temperature pressure Δ (measure) Δ (measure) Δ (measure) Δ (measure)
gas flow & infrared (humidity)

e) Cost effective

testing (testing) Δ (testing) Δ (testing) Δ (testing) Δ (testing)

* Smart sensor ~~capable~~ Capable of

↳ logic Functions

↳ make decisions.

↳ two-way Communication.

Components of smart sensors

[1] Network Capable application Processor: (NCAP)

- ↳ Communications
- ↳ interface control
- ↳ message routing
- ↳ TIM discovery & control.
- ↳ message encoding & decoding.

[2] Transducer interface module (TIM)

- ↳ TEDS storage.
- ↳ Triggering.
- ↳ Data transfer.
- ↳ Communications.
- ↳ Command Processing.
- ↳ Analog signal conditioning.

← 3 رسولات ال (Generations) بارة ال (sensors) الجزء الثالث
و ال (TIM) و ال (NCAP) ←

Advantages of smart sensors

- a) High reliability.
- b) Easy to design, use and maintain.
- c) small rugged packaging.
- d) High Performance.
- e) scalable - flexible system.
- f) minimum Cost.
- g) minimum interconnecting Cables.

* Disadvantages of smart sensors:-

- a) more complex than simple sensors (cause it consists of actuators and sensors)
- b) The complexity is much higher in the wired smart sensors ⇒ Costs are also higher.

Applications of smart sensors.

1] Optical sensor

↳ used to measure exposure in cameras, optical angle encoders and optical arrays.

2] Infrared detector array (University of Michigan)

~~↳ developed at solid laboratory~~
↳ infrared sensing element is developed using Polysilicon.

3] Integrated multisensor (University of California)

↳ chip contains MOS devices for signal conditioning with on chip sensor.

Industrial apps. of smart sensors

1] structural monitoring

↳ It is needed to detect damages of industrial infrastructure

2] Geological mapping

↳ needed to detect the minerals on the ~~geological~~ geological areas.

↳ Digital imaging & interpretation of tunnel geology.
↳ remote measurements of tunnel response.

SCADA Part 1

∴ (Control Systems) ← industrial control system (بعض أنواع كثيرة من الـ)

1) PLC

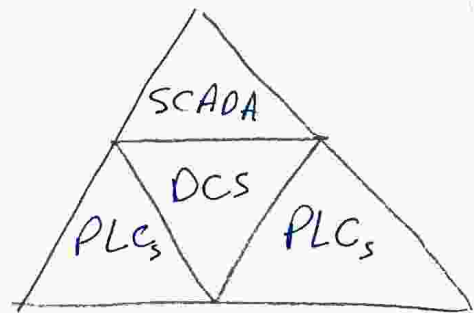
2) DCS

3) SCADA

SCADA

↳ used in industrial Processes such as (Manufacturing, Power Generation and distribution & ...etc)

↳ also used in some experimental Facilities such as nuclear Fusion.



Notes

↳ SCADA systems allow the operators to change the set points for the flow, and enable alarm conditions (such as loss of flow & high temperature)

↳ SCADA systems developed to run on DOS, VMS and UNIX, NT and Linux operating systems.

Hardware architecture

↳ It has two basic layers

① client layer

② Data server layer.

→ client layer: caters the human machine interaction

→ Data server layer: ~~handles most of~~

↳ handles most of process data control activities.

↳ ~~Communicate~~ Data servers communicate with devices in the field through process controllers. (~~PLCs~~)

↳ Data servers are connected to each other and to client stations via Ethernet LAN or WAN.

sub-systems of SCADA

1) HMI

2) RTUs

3) PLCs

4) Communication infrastructure

HMI (Human machine interface)

↳ device which presents process data graphically to a human operator

↳ Through it, human operator monitors and controls the process.

↳ operator can see a schematic representation of the plant being controlled.

← اللی شاف فیلم (BATMAN: Dark Knight) لما قرر (BATMAN)

بیستخم شاشة تتبع عشان یعرف مكان الجوکر و یدخل مورجان فریمان یتحكم فی الشاشة الضخمة دی

RTUs (remote terminal units)

↳ nodes of distributed SCADA based systems used in remote locations & converting sensor signals of digital data & sending digital data to supervisory system. ↳ slave/master device.

PLCs (Programmable logic controllers)

↳ Control industrial equipment and processes.
↳ They are the Primary Components in smaller control system configurations.
↳ used extensively in almost all industrial processes.
↳ used as Field devices cause they are more economical, Flexible and Configurable than special-purpose RTUs.

Communication infrastructure

↳ It connects the supervisory system to the remote terminal units.

Power supply sources

- ↳ the preferred to SCADA is direct current (DC) station battery system.
- ↳ DC can be more reliable than (AC) alternating current.
- ↳ PLCs available with DC power supplies rated at voltages between (24-125) VDC.

Features of SCADA

- a) real-time & historical trending
- b) Alarms.
- c) security
- d) Dynamic Process graphic.
- e) Data connectivity.
- f) Database connectivity.

* Real time & historical trending

↳ if your batch fails (or plant trips), you can simply go to historical trend data and do the analysis.

* Alarms

↳ we have alarm states for each I/P-O/P security.

↳ you can allocate certain facilities or features to operator, process people and maintenance dept

Application of SCADA system

- 1) Water management systems.
- 2) Electric Power.
- 3) Traffic signals.
- 4) mining Plants.
- 5) Environmental control systems.
- 6) Manufacturing systems.

a) water and Sewage:

↳ state water utilities use SCADA to monitor & regulate water flow, servoir levels, pipe pressure and other factors.

b) Electric Power generation, transmission and distribution:

↳ Electric utilities detect current flow and line voltage \Rightarrow to monitor the operation of circuit breakers & to take sections of the power grid online or offline.

c) Manufacturing

↳ manage parts inventories for just-in-time manufacturing.

↳ regulate industrial automation & robots.

↳ monitor process & quality control.

Advantages of SCADA systems

- a) Easy maintained (self diagnostic)
- b) Capability to do arithmetic function.
- c) Easily programmed and reprogrammed.
- d) ability to communicate with other controller or a master host computer.

SCADA Part 2

*What is network?

- ↳ interconnected system of computers.
- ↳ communication through specific protocols.
- ↳ better return ~~on~~ on investment.
- ↳ physical connectivity through copper/optical fiber or wireless media.

*Network security

- ↳ unauthorized access
- ↳ Denial of service.
- ↳ loss of integrity

→ How to ensure security?

- ↳ prevent a break-in, put locks.
- ↳ Have alarms to warn that a break-in has occurred.

* Basic security elements

- 1) Confidentiality 2) Integrity 3) Availability.

* Present security scenario (Notes)

- 1) dedicated networks are safe but expensive.
- 2) the internet is cheaper but comes with security risks.
- 3) Threats from external & internal users.
- 4) motivation is Political / monetary / or thrills.

* Wireless networking

↳ becomes popular.

↳ remote monitoring and control applications.

↳ ex: pump control.

↳ easy to intercept wireless signals.

* Similarities between industrial and business networks

- a) same owners & general goals.
- b) same technologies (TCP/IP, windows ... etc)
- c) common facilities.
- d) Interconnected at one or more points.

⇒ security approach of both types have a lot of similarities.

* Differences between Industrial & Business networks

Industrial networks

- 1) Reliability and response time and safety.
- 2) better security through Proprietary operating systems.

Business networks

- 1) Availability & delivery of service.
- 2) Different risk management Goals.

organizational aspects of security

- 1) security is not just a matter of technology.
- 2) what is the probability of security incident?
- 3) what are its risks?
- 4) " is the cost for security systems, training and periodic testing.
- 5) Get the users to understand and cooperate.

Network security measures

- 1) Authentication, authorization and accounting.
- 2) Encryption of data.
- 3) Intrusion detection & response.
- 4) routers and firewalls for access control & filtering.
- 5) VLANs as a security solution for LANs.

Security testing

- ↳ It ensures
- a) that security implementation is effective.
- b) " " " " Follows organizational security policies

Issues

- ↳ when to test?
- ↳ what tests to conduct?
- ↳ How frequently.
- ↳ on which systems.?
- ↳ who is responsible and for what?
- ↳ How much will it cost?

SCADA Part 4

* Why Scada

- ↳ save time and money. ↳ reliable.
- ↳ supervisory control over a particular system.

* What is Scada

- ↳ supervisory control and data acquisition.
 - ↳ operators / engineers / supervisors
 - ↳ monitoring limited remote / local
 - ↳ Analog / digital access & acquire info.

* Components manufactures & system manufacturers of Scada system?

- ↳ Automation solution. ↳ software ↳ hardware.

* Elements of SCADA

- ↳ sensors & actuators. ↳ RTUs / PLCs ↳ 7 trip

- ↳ Communication

- ↳ RTU

- ↳ Front end processor.
- ↳ Scada server.
- ↳ Historical / redundant / safety server.
- ↳ HMI computer.
- ↳ HMI software.

Sensors

Types

- 1) Pressure sensors.
- 2) Temperature sensors.
- 3) Light sensors.
- 4) Humidity sensors.
- 5) Wind speed sensors.
- 6) Water level sensors.
- 7) Distance sensors.

Actuators

- ↳ valves
- ↳ pumps
- ↳ Motors.

Alarms

- ↳ critical failure alarms.
- ↳ Good alarms.

Safety instrumented systems

Actions

- ↳ override the normal control system.
- ↳ Take over the actuators.

Communication

* Systems

- 1) Leased lines.
- 2) Internet
- 3) wireless comm. systems.

* Protocols

- 1) TCP/IP
- 2) Ethernet
- 3) DirectNet
- 4) ModBus
- 5) Profibus.

Front-end Processor

↳ Gathers all communications & convert them into SCADA Friendly communication.

↳ Communication interface between several RTU channels & the host master station computer.

SCADA server

↳ It can be web server. ↳ real-time decision maker.

uses

- 1) Data logging
- 2) Analyzing data.
- 3) serve the clients through a Firewall.

~~4) real time~~

Historical server

↳ logs the data from SCADA server & stores it as a backup, in case of disaster.

↳ safety server (basically)

HMI Computer

1) Access on the SCADA server.

2) control the system.

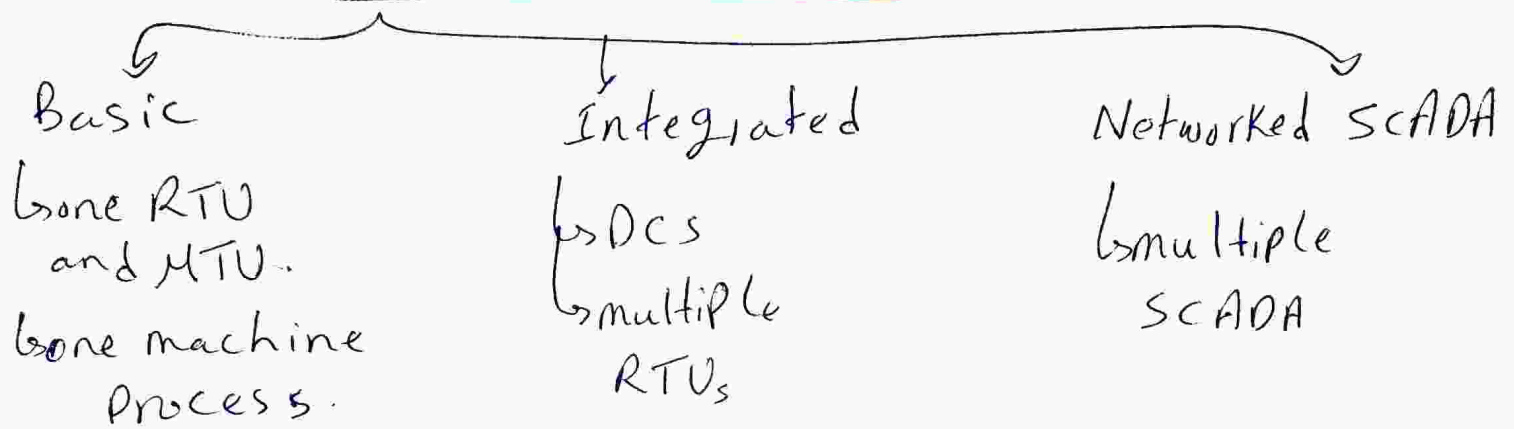
3) operator interface.

4) software

↳ user friendly.

↳ Programmable (C, C++)

SCADA types



ۛے آخر خایله ده • فیه جا جائے متکرره و فیه مهر

لحاجا = الى حاجا بي يطلع عليها.